TC3 Workshop: Cognitive Elements of Effective Collaboration

Theater Assessment Profiling System (TAPS) Contribution to Coalition Collaboration

Briefing on an advanced visualization scheme powered by a state space "engine" process in support of shared situation awareness, collaboration, and decision making

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Overview

- Effective SA in a JTF
- Definitions
- Goal of TAPS Contribution to Collaboration
- VSS “Under the Hood”
- Global War Game 2001 TAPS
- Situation Assessment
- Experimental Design
- Prototype and Top Sight™
- Summary

Requirements for Effective SA in a Joint Task Force (JTF) Setting

Real-world Situation

Theater "World"

Physical +

Clausewitz's "Red" Moral and Mental

Processes

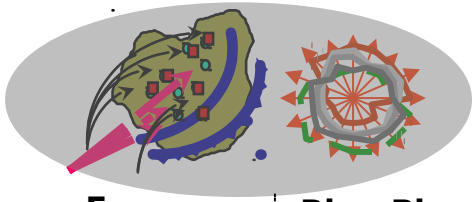
- Perception*
- Attention*
- Patterns & Long Term Memory*
- Synthesis, Analysis and Metacognitive Processes*

Product

Memory

Working Memory / Long-term Memory

Goals
Expectations
Mental Models
Schema



Force Location, Type, Strength

Blue Plan & Red Effects

Internal Representation of STATE

* TAPS Contributions

Mechanisms and Processes Involved in SA

(Endsley, 2000 in Theoretical Underpinnings of Situation Awareness: A critical Review)

Stress - Work-load - Interface - Complexity - Automation

Descriptions of TAPS & VSS

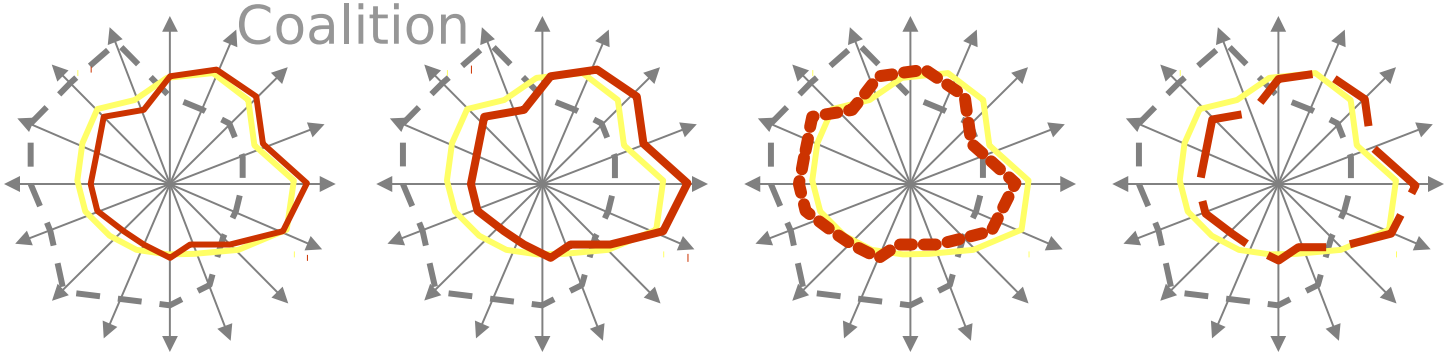
- **TAPS – Theater Assessment Profiling System-** An Effects-Based Operations (EBO) visualization that provides:
  - Commander's single view of his critical information environments as they progress, stagnate or fail (retrograde).
  - A high-level integrated view with "tailorable drilldown" enabled the commander to focus on normally disparate activities in the battlespace.
  - Explicit adversary and friendly (joint/coalition) EBO depictions
- **VSS – Valuated State Space™ -** A model utilizing multi-attribute utility theory that:
  - Mathematically captures the commander's intent, the desired effects on the enemy and unintended consequences for his planning-to-execution domain.
  - Incorporates the commander's priorities
  - Fuses and normalizes objective metrics and expert subjective data
  - Defines objectives using measures of effects
  - Defines measures of performance with intervals of achievement

Goal of TAPS Contribution to Coalition Collaboration

TAPS Contribution to Coalition Collaboration

- Facilitates collaboration between elements by highlighting differences in team SA between the major elements, such as, JFMCC, JFACC, JFLCC and coalition partners
- Visualizes situation assessment of joint/coalition high-level purpose and achieved effects on the enemy
- Provides access to lower level details for further specification of differences

TAPS-VSS Environments Components and Coalition

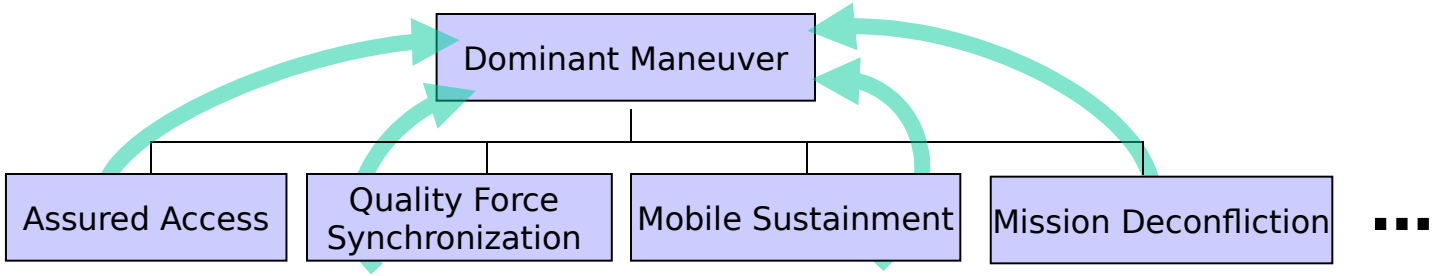


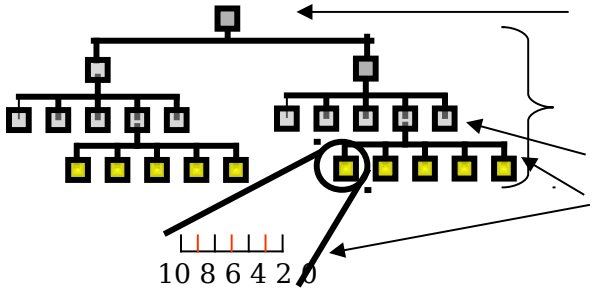
JFMCC JFACC JFLCC Coalition Partner

VSS™ Functionality -"Under the Hood"

- **Decomposition** of an objective into lower-level, more detailed sub-objectives

These sub-objectives define the high-level objective





Mission-Purpose

Levels of Decomposition

Attributes/Objectives

MOPs / Metrics – The VSS Intervals of Achievement

MOPs are at the Level in the State Space where metrics or SME judgments are mapped onto Intervals of Achievement that have Cardinal Value assignments

- **Operational Environment:** Objectives must be useful to be meaningful to the decision-maker. Objectives should facilitate explanations to others.
- **Completeness:** A set of subobjectives, i.e. the state space, is complete if it is effective in indicating the degree to which the overall objective is met.
- **Non-redundancy:** Objectives in the Valuated State Space should be preferentially distinguishable

*Hierarchy of Objectives from *Decisions with Multiple Objectives: Preferences and Value Tradeoffs* by

VSS Under the Hood

Key Characteristics

Subject Matter Expert inputs for:

- Determining mission-purpose
- Constructing the state space
- Determining “importance weight” of each objective/attribute
- Establishing the achievement / assessment criteria and numeric cardinal value assignments, i.e., utilities.
- Defining intervals of acheivement for Measures of Performance (MOPs) through which utility values are assigned

Logic engine that produces values for the TAPS display

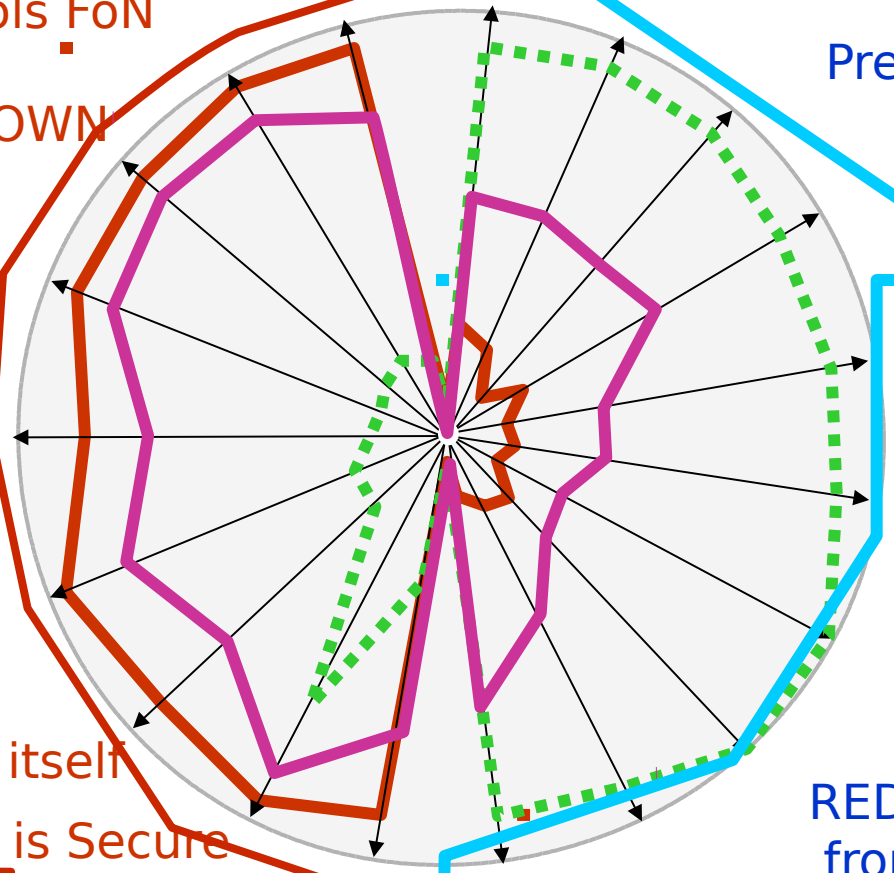
Mathematical/Computational Normalization Process

- Arithmetic & geometric means and default thresholds
- Future Research: Incorporation of other data sources, NSS
- Future Research: Evolutionary computation, fuzzy logic, etc.

What is needed to operate the TAPS-VSS model?

- Context
- Mission-Objectives (CCIRs,)
- SMEs
- Calibration of SMEs at MOP level
- Maintain Calibration of SME Population

GLOBAL 2001 – TAPS – Effects on RED & BLUE Strategy



Effects on Red

RED can attack BLUE AOI

RED Controls FoN

Sustain RED in BROWN

Sustain Red in TAN

Info Ops/SA Effective

Asym. Warfare Effective

RED can defend itself

RED Regime is Secure

International Support

RDO Enablers

Info Superiority

Dom Maneuver

Precision Engmt

Deploy & Sustain

JOA Secure from RED

JOA Freedom of Navigation

RED removed from TAN

RED removed from BROWN

Degrade RED Offense

Coalition Resolve

Blue Objectives

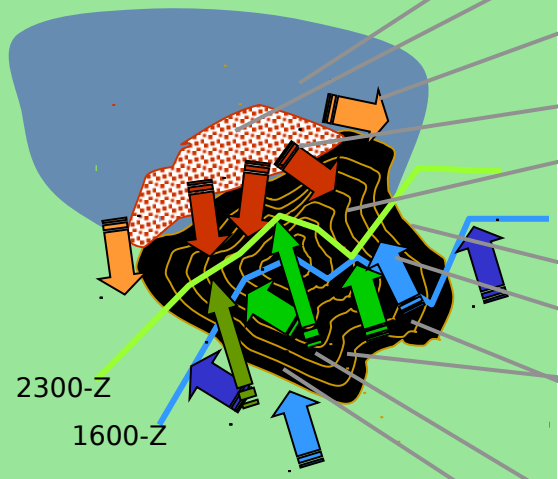
Current Report (1)
Interval Report (2)
Interval Report (3)
Interval Report (4)
Interval Report (5)
Interval Report (6)

Initial Condition

Desired End State

Situation Assessment Deltas Identified and Highlighted by Major JTF Element

Battle space
Physical, Mental and
Moral Aspects



Coalition A

Coalition B

Blue-RED
Team

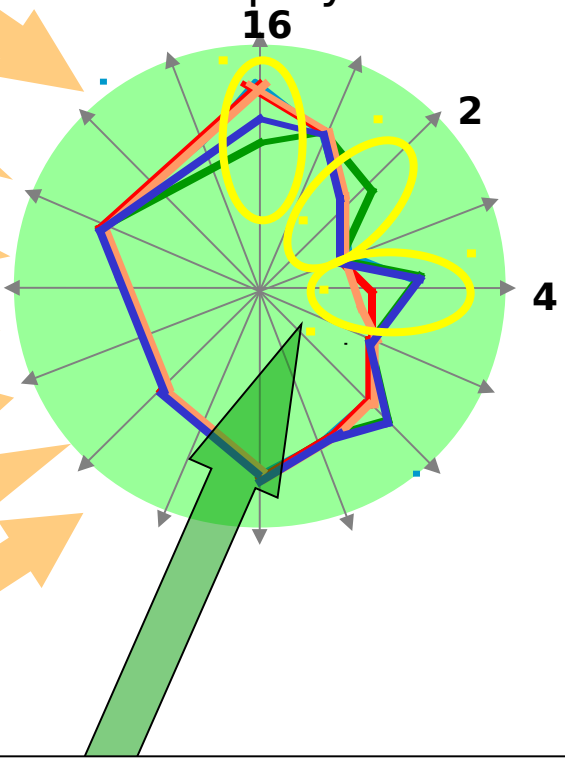
JFMCC

JFACC

Coalition C

JFLCC

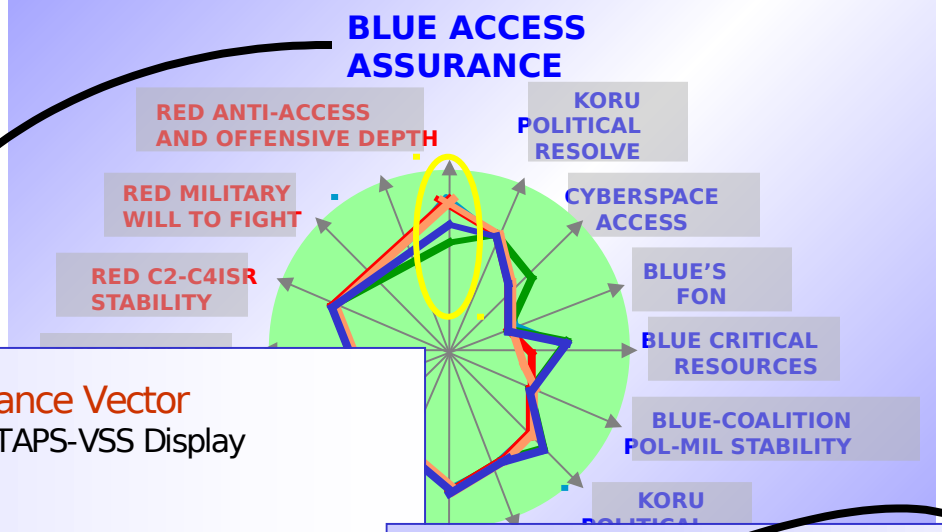
Combined JTF Effects
Status Collaboration
Display



- **Data collected for major elements shown in Combined Display**
- **Yellow Show Deltas in Situation Assessment by High-level purpose**
- **Drill down into Vectors 16, 2 and 4 will disclose details**

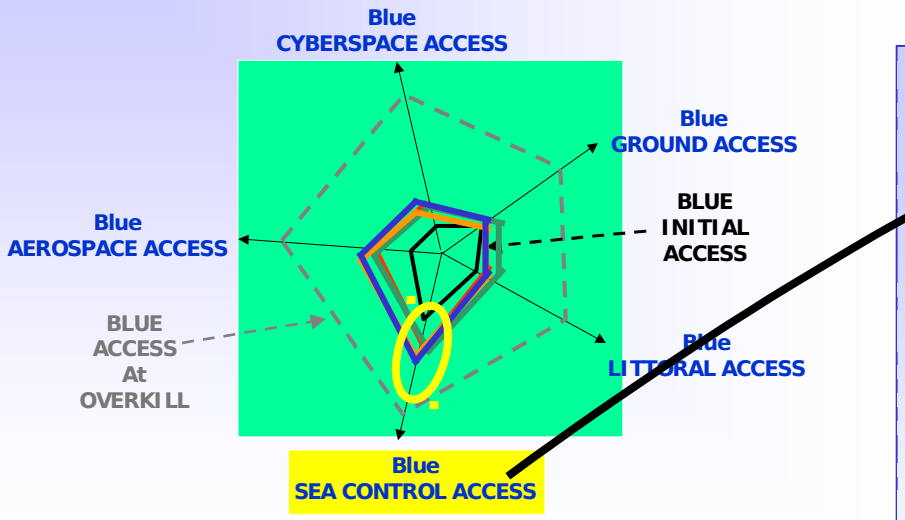
Drill Down to Second level MOEs

High-Level Display



Blue Access Assurance Vector

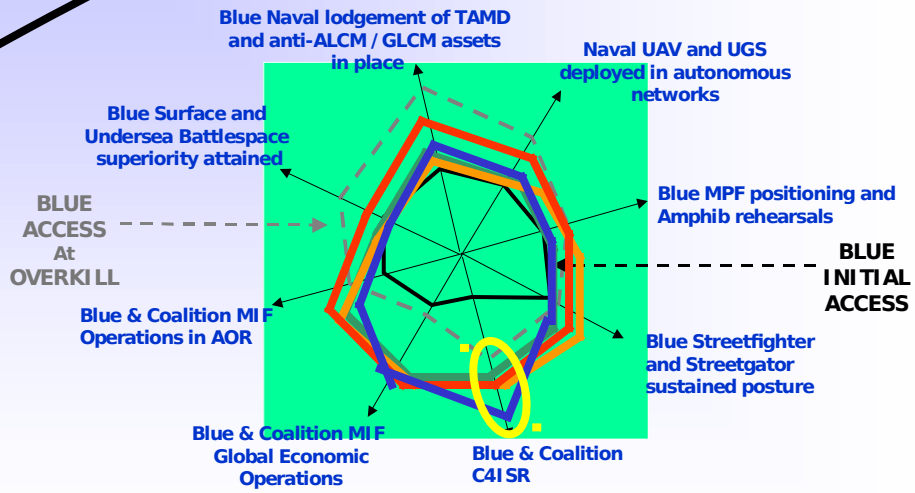
Second Level Nesting of TAPS-VSS Display



Drill Down to Third level MOEs/MOPs

(Blue Access Assurance) -> Sea Control Access

Third Level Nesting of TAPS-VSS Display


Blue Naval lodgement of TAMD and anti-ALCM / GLCM assets in place
Naval UAV and UGS deployed in autonomous networks
Blue Surface and Undersea Battlespace superiority attained
BLUE ACCESS At OVERKILL
Blue MPF positioning and Amphib rehearsals
BLUE INITIAL ACCESS
Blue & Coalition MIF Operations in AOR
Blue Streetfighter and Streetgator sustained posture
Blue & Coalition MIF Global Economic Operations
Blue & Coalition C4ISR
Initial Condition
Desired End State

Level 2 SA – Comprehension Enabled by Detailed Views of MOE's

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2x2 Experimental Design

Innovative Concept to Enhance JTF & CTF Collaboration

	Training	Trial I		Trial II	
Treatment A TAPS-VSS	**1. Experiment set-up, org., process, scenario, etc.** **2. Treatment technologies** **3. Schedules** **4. Debrief Questionnaires**	Situation Briefs **CG Scenario**	**Debrief**	Situation Briefs **CG Scenario**	**Debrief**
Treatment B TBD		Situation Briefs **CG Scenario**		Situation Briefs **CG Scenario**	

- Teams of Component/ Coalition Commanders
  1. JFMCC
  2. JFACC
  3. JFLCC
  4. Coalition Country A
  5. Coalition Country B

- Data Collection
  1. Questionnaires
  2. Debriefings
  3. Observations
  4. Situation Awareness probes

✓ Cobra Gold 02

✓ FBE-J

- Success Criteria
  1. Improved Situation Assessments for Components/Coalition
  2. Identification of specific “CCIR Deltas” in Situation Assessment between JTF Elements
  3. Improved

TAPS-VSS Prototype

- TAPS Prototype Events
  - Global Wargame 2000 (August) & 2001 (July)
    - The VSS metrics construct was validated as an appropriate way to track disparate topics relevant to the commander
    - TAPS as a prototype visualization provided both a high level roll-up assessment of input data and illustrated trend progression, stagnation or retrograde
  - US Joint Forces Command Presentation LOE – July ‘01
    - Formal Report due Dec 01
- Scheduled Events
  - Cobra Gold 02 – Attended USPACOM Joint Mission Force PC and CG02 IPC and MPC. Attending FPC in mid Jan 2002.
  - Fleet Battle Experiment Juliet – Attended IPC/MPC

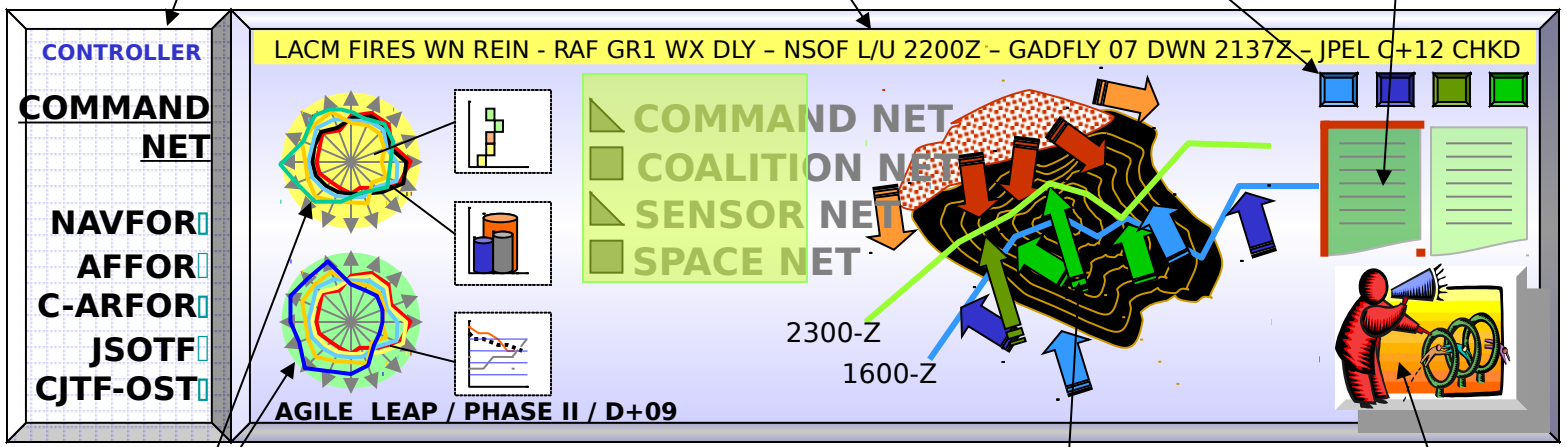
Top Sight™
Command Information Viewport

Data control panel

Information "Push" Scrolling Informatio Link Ticker

3D Audio

Component Flash, Priority Messages



TAPS trend reports on 'Commander's Intent' progression nd Element Situation Assessments

Battlespace Maneuver Situation

VTC Port

Personnel Digital Assistant/Tablet Viewport for Coalition Partners

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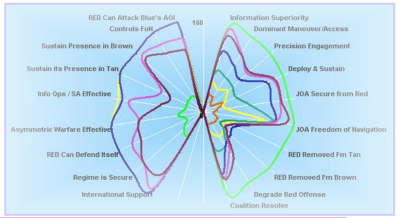
Summary



- TAPS-VSS was successfully used in Global Wargame 2000 & 2001, and JFCOM UV01 Presentation LOE
- Senior Military Leadership has encouraged continued development
- Navy operational and technical communities are supportive and participating
- Improved prototype targeted for FBE – Juliet and Cobra Gold 02
- SYS working to develop Component/Coalition Shared SA and Situation Assessment Collaboration Scheme
- Experimentation, research and studies continue

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